INDOOR AIR QUALITY ASSESSMENT

Newman Elementary School
1155 Central Street
Needham, Massachusetts 02492

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health
Indoor Air Quality Program
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Background/Introduction

At the request of a concerned parent and the Needham School Department (NSD), the Massachusetts Department of Public Health (MDPH) Bureau of Environmental Health (BEH) conducted an indoor air quality assessment at the Newman Elementary School (NES), 1155 Central Avenue, Needham, Massachusetts. On March 28, 2008, the NES was visited by Mike Feeney, Director of BEH's Indoor Air Quality Program (IAQ) Program. Mr. Feeney was accompanied by Cory Holmes, Susan Koszalka, Sharon Lee and James Tobin, Environmental Analysts in the IAQ Program. The assessment was prompted by concerns related to the condition of the building's aging mechanical ventilation system, as well as concerns related to mold and associated musty odors in and around the NES media center.

The NES is a two-story red brick building complex constructed in the early 1960s. The building was reportedly renovated in 1993, 1995, and again during 1997 to 1998. The school is a complex of buildings that consists of upper and lower levels constructed around a central courtyard. From a heating /ventilation system standpoint, the building essentially functions as separate wings, with the East and West Wings connected by heated walkways (Map 1). The East Wing consists of the media center (the library and NEAT center), kindergarten classrooms, administrative offices, auditorium, conference rooms, science center and gymnasium. The West Wing consists predominately of general classrooms.

The building was previously visited by BEH staff in March 2007. A report detailing conditions observed at the time of that visit and recommendations for improving indoor air quality was issued (MDPH, 2007). Appendix A is a summary of actions taken in response to the previous assessment. Subsequent to the March 2007 BEH visit, the Needham Public Schools (NPS) contracted with a consultant, Occuhealth, Inc. (OHI), to conduct mold sampling. Based on the findings of that report, the consultant offered “no recommendations” for corrective actions (OHI, 2008a). Dust characterization was also conducted by OHI, which resulted in a recommendation to clean the ductwork (OHI, 2008b).

Methods

During the March 2008 inspection, air tests were conducted by BEH for carbon dioxide, carbon monoxide, temperature and relative humidity with the TSI, Q-TRAK™ IAQ Monitor, Model 8551. Air tests for airborne particle matter with a diameter less than 2.5 micrometers were taken with the TSI, DUSTTRAK™ Aerosol Monitor Model 8520. BEH staff also performed a visual inspection of building materials for water damage and/or microbial growth. Moisture content of porous building materials was measured with a Delmhorst, BD-2000 Model, Moisture Detector equipped with a Delmhorst Standard Probe.

Results

The school houses approximately 725 students in pre-K through grade 5 and approximately 60 staff members. Tests were taken during normal operations at the school. Results for the East Wing appear in Table 1. Results for the West Wing appear in Table 2.

Discussion

Ventilation

It can be seen from Table 1 that carbon dioxide levels were above 800 parts per million (ppm) in of 8 of 22 areas surveyed in the East Wing, indicating adequate ventilation in approximately two thirds of the areas surveyed during the assessment. Carbon dioxide levels in the West Wing were above 800 ppm in of 22 of 46 areas (Table 2) indicating poor air exchange in almost half of the areas surveyed during the assessment.

Mechanical ventilation for both the east and West Wings is provided by air-handling units (AHUs) located in mechanical rooms. Fresh air is drawn through air intakes on the exterior of the building and distributed via air diffusers located on window ledges or mounted on the ceilings/walls. Air is ducted back to AHUs via ceiling or wall-mounted return vents. Both supply and return vents were obstructed by various items in a number of areas throughout the building (Pictures 1 to 4).

Please note, in numerous areas throughout the East Wing, air diffusers were sealed with duct tape in order to prevent silt deposition (Pictures 5 and 6). In addition, air supply vents in the NEAT and media centers were ducted to the outside (Picture 7), to allow dispersion of particles and continued operation of the AHU for this area.

The efficiency of return vents is limited by their location. In several classrooms, exhaust vents are located above hallway doors. When classroom doors are open, exhaust vents will tend to draw air from both the hallway and the classroom reducing the effectiveness of the exhaust vent to remove common environmental pollutants.

To maximize air exchange, the MDPH recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy. In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room. It is recommended that HVAC systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994). The mechanical ventilation systems were reportedly balanced in 1996-1997 following renovations.

The Massachusetts Building Code requires that each room have a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or openable windows (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens, a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

The MDPH uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information concerning carbon dioxide, consult Appendix B.

Temperature measurements the day of the assessment ranged from 66^{o} F to 76^{o} F in the East Wing (Table 1), which were within the MDPH recommended comfort range in the majority of areas surveyed. Temperature measurements in the West Wing ranged from 71^{o} F to 77^{o} F (Table 2), which were within of the MDPH recommended comfort range. The MDPH recommends that indoor air temperatures be maintained in a range of 70^{o} F to 78^{o} F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply.

The relative humidity measured in the building ranged from 24 to 35 percent in the East Wing (Table 1) and 25 to 31 percent in the West Wing (Table 2), both of which were below the MDPH recommended comfort range in all areas the day of the assessment. The MDPH recommends a comfort range of 40 to 60 percent for indoor air relative humidity. Relative humidity levels in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

The design of the NES complex is atypical in the New England area and appears to be better suited for an arid climate. The exterior wall system is formed by a combination of metal frames/spandrels and glass windows, which reside on large cement slabs that extend several feet horizontally past the wall system to form ledges (Picture 8). The slab is sloped downward, away from the window system (Picture 9). All ledges have troughs with holes to allow rainwater to drain from the ledges. While this design allows rainwater to drain away from the window system, snow can collect on the ledge and drift against the exterior wall, particularly in snowy New England winters. This can result in damage to the building's exterior and interior. BEH staff examined conditions around the exterior of the building and observed sources for water penetration and conditions indicating water pooling/penetration:

- **Lack of downspouts**: Gutters and downspouts in several areas were observed to be damaged and/or missing (Pictures 10 and 11). As a result, water was emptying against the exterior of the building, allowing rainwater to pool on the concrete ledges extending from the window system and the ground at the base of the building.
- **Clogged drainage systems**: Pine needles and other debris were observed to be clogging intact gutters/downspouts and drainage holes on the building's ledges (Picture 12).
- **Moss growth:** Exterior brickwork and cement at the corners of the building, especially in the media center area, appear to be chronically wet and moss growth was observed (Pictures 13 and 14). Moss growth is a sign of heavy/continuous water exposure which can undermine the structural integrity of the brick and mortar by holding moisture against the building.
- **Cracks in the exterior wall cement**: The ledges and cement portions of the exterior walls were observed with hairline cracks. These portions of the exterior wall are exposed to a significant amount of rain water, as evidenced by the presence of staining (Picture 15) and moss (Pictures 16 and 17). Under wind driven conditions, rain can pass through these breaches into the building interior. These conditions can undermine the integrity of the building envelope and provide a means of water entry by capillary action into the building through exterior walls, foundation concrete and masonry (Lstiburek & Brennan, 2001).

Over time, the aforementioned conditions can allow a significant amount of moisture to penetrate the building. Of significance is the current impact these conditions have on the East Wing, particularly the NEAT/media center areas.

East Wing

Building occupants reported a musty odor in the East Wing that centers around the media center. BEH staff noted a strong, musty odor in the media center and surrounding areas including: the hallway outside the media center, the reception area of the administrative offices, the hallway leading to the NEAT/media center and the main lobby (Map 2). The musty odor was most prevalent in the library section of the media center. *No musty odors were reported in the north section of the East Wing or in any section of the West Wing*. Based on these observations, the odor issue appears limited to the *south section of the East Wing* (Map 3). The north and south sections of the East Wing are serviced by a different mechanical ventilation system, which indicates that the musty odor problem is likely tied to the areas serviced by the East Wing south section of the building, the areas around the media center.

To isolate the odor source, BEH staff examined conditions within the media center and determined that the books/paper goods and the carpeting were potential sources. BEH staff spot-checked books in the library for water damage and/or musty odors. No books were found to have musty odors. The most likely source of the odor in this area appears to be the wall-to-wall carpeting. The New England area has experienced a particularly wet winter, marked by several wind driven rainstorms. From January to March 2008, the greater Needham area received the equivalent of over one and one half feet of rain (Weather Underground, 2008). This unusually wet weather is likely a source responsible for the moisture in the carpeting. The following are potential sources contributing to the moistened carpet in the media center:

- **Media center fresh air intake**: The media center fresh air intake is located in a cement lined pit beneath the ledge near room 305 (Picture 18). The pit faces west and is subject to direct rainfall. Moreover, a drainage hole for the ledge around room 305 empties directly into this fresh air intake pit (Picture 19). On the day of this assessment BEH staff found this pit to be soaked with water as a result of a rainstorm. Additionally, the floor of the pit was covered with a layer of pine needles. This pine needle layer will keep the floor of the fresh air intake pit moist and be a significant source of moisture and related odors that can be captured and distributed by the HVAC system.
- **East Wing South Section AHU air mixing room**: BEH staff examined the AHU providing fresh air to the media center, which is located in a mechanical room (Picture 20). Fresh air to the media center is supplied by window sill mounted fresh air diffuser connected to the AHU via ductwork that is partially located in the cement slab (Picture 21). Air is exhausted from the media center through return vents connected to ductwork. The return vent ducts terminate in the wall of the AHU room (Picture 22). Instead of installing ducts to connect the return vents to AHUs, the entire room was designed to serve as a return duct. The return air vent on each AHU is open to the room (Picture 23). In this configuration, the AHU becomes depressurized drawing air from the return air ducts and in turn, into the occupied spaces. The floor of this AHU room contains a floor drain (Picture 24). The floor drain likely has a dry trap, which could allow for sewer gas odors and moisture to be drawn into the AHU. Adjacent to the AHU room is a custodial closet that contains a sink and a non-functional exhaust vent. If this sink has a dry trap, sewer gas odors and moisture can also be drawn into the AHU. Moist air from the non-functioning exhaust vent can be another source of moisture. Depressurization created by

the media center AHU will draw air from the custodial closet drawing odors from the dry sink trap.

- **Breach(es) In the Media Center HVAC System Ductwork**: BEH staff examined ductwork in the media center crawlspace. A number of seams that are likely to draw air from the crawlspace exist, which can serve as another possible moisture/odor source to be captured by the HVAC system. The ductwork for the administrative offices passes into the concrete slab. If poor drainage exists for the ledges in this location water could potentially seep through the concrete and come into contact with the ductwork. The ledge outside the administration offices is covered with debris and pine needles that can also hold and dam water to prevent proper drainage. The large grainy material denoted by OHI in its dust characterization analysis may be dirt/concrete particles that have entered the vent system though seams via water penetration.

Each of these aforementioned conditions can serve as potential moisture sources that would increase relative humidity in the media center. Over time, the carpeting can become wet through chronic exposure and absorption of moisture.

The US Environmental Protection Agency (US EPA) and the American Conference of Governmental Industrial Hygienists (ACGIH) recommends that porous materials be dried with fans and heating within 24 to 48 hours of becoming wet (US EPA, 2001; ACGIH, 1989). If porous materials are not dried within this time frame, mold growth may occur. Cleaning cannot adequately remove mold growth from water-damaged porous materials. The application of a mildewcide to mold contaminated, porous materials is not recommended.

West Wing

Leaks were reported by building occupants in a number of areas in the West Wing. BEH staff observed water stains in the corner of a restroom adjacent to the Speech and Language room (Picture 25). Staff reported that the staining resulted from flooding the bathroom. Staff also reported that occasional flooding occurs in the Speech and Language Office.

A leak was reported in a bathroom across room 120, near the north side of the building. BEH staff observed damage on the interior wall shared by the bathroom and hallway. A column of wall tiles in the bathroom appeared shifted and no longer perpendicular to other tiles, indicating water damage. Slight water staining was observed on the hallway wall, indicating water had been trickling down this wall.

Occasional water pooling was reported in the bathroom for room 111. Water pooling against the wall area near the bathroom door has reportedly been observed. BEH staff examined the bathroom and the classroom cabinet on the opposite side of this wall. A pipe located within the classroom's cabinet passes into the wall shared by the bathroom and classroom (Picture 26). The pooling water in the bathroom may be an indication that this pipe is either leaking or that condensation may be forming on the pipe.

BEH staff also observed potential sources for moisture/mold growth in areas throughout the NES. Several classrooms had a number of plants. Classroom 107 had a shelved greenhouse (Picture 27) at the base of which BEH staff observed pooling water (Picture 28), indicating overwatering. Moistened plant soil and drip pans can be a source of mold growth. Plants should be equipped with drip pans; the lack of drip pans can lead to water pooling and mold growth on windowsills. Plants are also a source of pollen. Plants should be located away from the air stream of ventilation sources to prevent the aerosolization of mold, pollen or particulate matter throughout the classroom.

A number of classrooms had water-damaged/missing ceiling tiles which can indicate sources of water penetration (Picture 29; Tables 1 and 2). In the gym, the roof drain was leaking, as evidenced by the water-damaged ceiling (Picture 30). In addition, periodic leaks from the skylights were reported in room 305, during wind driven rains. Water-damaged ceiling tiles can provide a source of mold and should be replaced after a water leak is discovered and repaired.

Peeling paint was also observed in a few areas (Picture 31). A coat of paint can serve as a water impermeable barrier, which can trap moisture. While plaster is not a viable source for mold growth, water trapped in spaces between the paint and plaster can become mold growth media.

Breaches were observed between the counter and sink backsplashes in some classrooms (Tables 1 and 2). If not watertight, water can penetrate through these seams. Improper drainage or sink overflow can lead to water penetration into the countertop, cabinet interior and areas behind cabinets. Water penetration and chronic exposure of porous and wood-based materials can cause these materials to swell and show signs of water damage, which can subsequently lead to mold growth (Picture 32).

Refrigerators were observed on carpeting in a number of areas (Picture 33). When warm, moist air passes over the cooler refrigerator, condensation can collect on the surface. Condensation is the collection of moisture on a surface at or below the dew point. The dew point is the temperature that air must reach for saturation to occur. Over time, condensation can collect and form water droplets. These water droplets can drip from the refrigerator surface to the carpeting. As discussed previously, moistened carpeting can be a source of mold growth.

Similarly, water bubblers are located over carpeting in some areas. As with refrigerators, condensation can form on the surface of a water bubbler in a warm, moist environment. The condensation can drip from the bubbler and moisten carpeting. Overflow of the water bubbler or spills that often occur around the water source can also moisten carpeting.

A number of aquariums and terrariums were located in classrooms. Aquariums should be properly maintained to prevent microbial/algae growth, which can emit unpleasant odors. Similarly, terrariums should be properly maintained to ensure soil does not become a source for mold growth.

Some rooms are equipped with exterior doors. Several of these doors had damaged weather stripping and light could be seen penetrating through the spaces underneath the door from the outdoors (Picture 34). Spaces beneath exterior doors can serve as sources of water entry into the building, causing water damage and potentially leading to mold growth. In addition, these spaces can serve as pathways for insects, rodents and other pests into the building.

Other IAQ Evaluations

Indoor air quality can be negatively influenced by the presence of respiratory irritants, such as products of combustion. The process of combustion produces a number of pollutants. Common combustion emissions include carbon monoxide, carbon dioxide, water vapor and smoke (fine airborne particle material). Of these materials, exposure to carbon monoxide and particulate matter with a diameter of 2.5 micrometers (μm) or less (PM2.5) can produce immediate, acute health effects upon exposure. To determine whether combustion products were present in the school environment, BEH staff obtained measurements for carbon monoxide and PM2.5.

Carbon monoxide is a by-product of incomplete combustion of organic matter (e.g., gasoline, wood and tobacco). Exposure to carbon monoxide can produce immediate and acute health affects. Several air quality standards have been established to address carbon monoxide and prevent symptoms from exposure to these substances. The MDPH established a corrective action level concerning carbon monoxide in ice skating rinks that use fossil-fueled ice resurfacing equipment. If an operator of an indoor ice rink measures a carbon monoxide level over 30 ppm, taken 20 minutes after resurfacing within a rink, that operator must take actions to reduce carbon monoxide levels (MDPH, 1997).

The American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE) has adopted the National Ambient Air Quality Standards (NAAQS) as one set of criteria for assessing indoor air quality and monitoring of fresh air introduced by HVAC systems (ASHRAE, 1989). The NAAQS are standards established by the US EPA to protect the public health from six criteria pollutants, including carbon monoxide and particulate matter (US EPA, 2006). As recommended by ASHRAE, pollutant levels of fresh air introduced to a building should not exceed the NAAQS levels (ASHRAE, 1989). The NAAQS were adopted by reference in the Building Officials & Code Administrators (BOCA) National Mechanical Code of 1993 (BOCA, 1993), which is now an HVAC standard included in the Massachusetts State Building Code (SBBRS, 1997). According to the NAAQS, carbon monoxide levels in outdoor air should not exceed 9 ppm in an eight-hour average (US EPA, 2006).

Carbon monoxide should not be present in a typical, indoor environment. If it *is* present, indoor carbon monoxide levels should be less than or equal to outdoor levels. On the day of assessment, outdoor carbon monoxide concentrations were non-detect (ND). Carbon monoxide levels measured in both wings of the school were also ND (Tables 1 and 2).

The US EPA has established NAAQS limits for exposure to particulate matter. Particulate matter is airborne solids that can be irritating to the eyes, nose and throat. The NAAQS originally established exposure limits to particulate matter with a diameter of 10 μm or less (PM10). According to the NAAQS, PM10 levels should not exceed 150 microgram per cubic meter ($\mu g/m^3$) in a 24-hour average (US EPA, 2006). These standards were adopted by both ASHRAE and BOCA. Since the issuance of the ASHRAE standard and BOCA Code, US EPA established a more protective standard for fine airborne particles. This more stringent PM2.5 standard requires outdoor air particle levels be maintained below 35 $\mu g/m^3$ over a 24-hour average (US EPA, 2006). Although both the ASHRAE standard and BOCA Code adopted the PM10 standard for evaluating air quality, MDPH uses the more protective PM2.5 standard for evaluating airborne particulate matter concentrations in the indoor environment.

Outdoor PM2.5 concentrations were measured at 3 $\mu g/m^3$ (Table 1). PM2.5 levels within the East Wing ranged from 4 to 26 $\mu g/m^3$ (Table 1). In the West Wing, PM2.5 levels ranged from 4 to 13 $\mu g/m^3$. PM2.5 levels in both wings were below the NAAQS PM2.5 level of 35 $\mu g/m^3$ (Table 2). Frequently, indoor air levels of particulates (including PM2.5) can be at higher levels than those measured outdoors. A number of mechanical devices and/or activities that occur in schools can generate particulate during normal operations. Sources of indoor airborne particulates may include but are not limited to particles generated during the operation of fan belts in the HVAC system, cooking in the cafeteria stoves and microwave ovens; use of photocopiers, fax machines and computer printing devices; operation of an ordinary vacuum cleaner and heavy foot traffic indoors.

Indoor air concentrations can be greatly impacted by the use of products containing volatile organic compounds (VOCs). VOCs are carbon-containing substances that have the ability to evaporate at room temperature. Frequently, exposure to low levels of total VOCs (TVOCs) may produce eye, nose, throat and/or respiratory irritation in some sensitive individuals. For example, chemicals evaporating from a paint can stored at room temperature would most likely contain VOCs. In an effort to identify materials that can potentially increase indoor VOC concentrations, BEH staff examined classrooms for products containing these respiratory irritants.

Classrooms contained dry erase boards and dry erase board markers. Materials such as dry erase markers and dry erase board cleaners may contain VOCs, such as methyl isobutyl ketone, n-butyl acetate and butyl-cellusolve (Sanford, 1999), which can be irritating to the eyes, nose and throat.

Cleaning products were found on countertops and in unlocked cabinets beneath sinks in some classrooms. Like dry erase materials, cleaning products contain VOCs and other chemicals that can be irritating to the eyes, nose and throat of sensitive individuals. Unlabeled/poorly labeled spray bottles were also observed in some classrooms. Products should be kept in their original containers, or should be clearly labeled as to their contents, for identification purposes in the event of an emergency. Further, material safety data sheets (MSDS) for all cleaning products must be available at a central location in the building.

Air fresheners and deodorizing materials were observed in some areas. Air fresheners and deodorizers contain chemicals that can be irritating to the eyes, nose and throat of sensitive individuals. Furthermore, deodorant agents do not remove materials causing odors, but rather mask odors that may be present in the area.

Concerns were raised about the presence of degrading insulation within the media center ductwork. The interior of duct appears to be bare sheet metal without any insulation (Picture

35). To investigate this matter further, BEH staff entered the crawlspace beneath the media center. Ductwork supplying air to both the media center and the administration office was also not insulated externally (Picture 36). The lack of insulation in accessible areas of the ductwork would tend to eliminate eroding fiberglass or asbestos insulation as a source of pollutants. The source of fiberglass that were measured in trace amounts in laboratory sampling analyzed by an independent contractor (GAQCI, 2008) is like from damaged pipe insulation inside the east wing south section AHU air mixing room (Picture 20, 24).

Other conditions that can affect indoor air quality were observed during the assessment. In several classrooms, items were observed on the floor, windowsills, tabletops, counters, bookcases and desks (Picture 37). The large number of items stored in classrooms provides a source for dusts to accumulate. These items (e.g., papers, folders, boxes) make it difficult for custodial staff to clean. Items should be relocated and/or be cleaned periodically to avoid excessive dust build up. In addition, these materials can accumulate on flat surfaces (e.g., desktops, shelving and carpets) in occupied areas and subsequently be re-aerosolized causing further irritation.

Large throw pillows and upholstered furniture (i.e., couches) were seen in a few classrooms (Pictures 4 and 37). These upholstered items are covered with fabric that comes in contact with human skin. This type of contact can leave oils, perspiration, hair and skin cells. Dust mites feed upon human skin cells and excrete waste products that contain allergens. Further, increased relative humidity levels above 60 percent can perpetuate dust mite proliferation (US EPA, 1992). In order to remove dust mites and other pollutants, frequent vacuuming of upholstered furniture is recommended (Berry, 1994). It is also recommended that if upholstered furniture is present in schools, it should be professionally cleaned on an annual basis or every six months if dusty conditions exist (IICRC, 2000).

High efficiency particulate air (HEPA) purifiers were observed on the floor in several locations (Picture 38). Air purifiers should be placed within the breathing zone rather than at floor level. In addition, this equipment is normally equipped with filters that should be cleaned or changed as per manufacturer's instructions to prevent build up and re-aerosolization of dirt, dust and particulate matter.

Finally, several personal fans and return/exhaust vents were occluded with dust and debris (Pictures 39 and 40). Dust can be a source for eye and respiratory irritation. Re-activated personal fans can serve to distribute dust. If exhaust vents are not functioning, backdrafting can occur and aerosolize dust particles. At the time of assessment, BEH staff recommended vacuuming exhaust vents for rooms 407 and 409 with a HEPA-filtered vacuum.

Evaluation of Available Health Data

In addition to indoor air quality, concerns were expressed about possible health impacts associated with exposure to indoor air pollutants at the Newman School. To best address to this concern, MDPH/BEH evaluated pediatric asthma data for the Newman School. MDPH/BEH has been conducting statewide pediatric asthma surveillance since the 2003-2004 school year. Pediatric asthma data are reported by school nurses at schools with at least some of grades K-8. An earlier study carried out by MDPH/BEH in the Merrimack Valley region of the state demonstrated 96 percent agreement between doctor diagnosed asthma and school based asthma numbers, so the data are considered very reliable for evaluation/comparison.

Table 3 shows the pediatric asthma data for school years for which data are currently available (i.e., 2003-2004, 2004-2005, and 2005-2006) for all Needham schools with at least some of grades K-8, including the Newman School. The pediatric asthma rate for the Newman School was less than the statewide rate for the school years 2003-2004 and 2005-2006. For the 2004-2005 school year, the pediatric asthma rate was slightly higher (10.6 at Newman versus 10.0 for the state), but this difference was not statistically significant. However, while children attending the Newman Elementary School are not experiencing unusual rates of pediatric asthma, children with pre-existing asthma are likely to experience exacerbations if mold/moisture issues are not addressed. It is important to note that a study conducted by MDPH in 2003-2006 demonstrated that children in schools with greater amounts of mold and moisture present had significantly higher rates of pediatric asthma than those attending school without the presence of mold and moisture.

Conclusions/Recommendations

Several issues were identified as part of the DPH inspection that can affect indoor air quality. While a number of the issues observed are typical of elementary school environments (presence of plants, dust control, building maintenance), particularly those built several decades ago the moisture issues warrant attention. In view of the findings at the time of the assessment, the following recommendations are made to improve indoor air quality:

1. Remove carpet and coving along all exterior walls from the media center. Carpeting should be removed in a manner consistent with recommendations in "Mold Remediation in Schools and Commercial Buildings" published by the US Environmental Protection Agency (US EPA, 2001). This document is available from the US EPA website:

http://www.epa.gov/iaq/molds/mold_remediation.html. Replace with a non-porous material (e.g., non-slip tile).

2. Remove and examine behind the gypsum wallboard along the exterior walls of the media center if odors persist. Water damaged gypsum wallboard should be removed.
3. Remove the pine needles from the media center fresh air intake pit.
4. Install gutters/downspouts to redirect water from ledge drains to prevent water from emptying into the media center's fresh air intake pit.
5. Repair/replace all damaged/missing gutters and downspouts, particularly the one servicing the media center walls.
6. Consider erecting a shield over the media center fresh air intake pit to prevent and reduce water penetration.
7. Ensure that the floor drain in the media center AHU room has water poured into its trap twice a week. If the drain does not have a discernable purpose, consider sealing this floor drain.
8. Seal all holes in the ceiling, walls and floor of the media center AHU room.
9. Install weather stripping and door sweeps to exterior doors.
10. Repair the exhaust vent in the custodian room adjacent to the media center AHU room.
11. Repair all cracks in the cement of the ledges and exterior wall.
12. Remove pine needles and other materials from the ledges to aid drainage.
13. Seal all seams of exposed ductwork in the media center crawlspace.
14. Seal all holes in the interior walls of the media center created when computer equipment was retrofitted in the NES.

15. Continue to operate all ventilation systems throughout the building (e.g., gym, auditorium, classrooms) continuously during periods of school occupancy to maximize air exchange.
16. Work with HVAC vendor to examine methods of increasing fresh air intake.
17. Remove all obstructions from supply and exhaust/return vents to facilitate airflow.
18. Ensure classroom doors are closed to improve air exchange.
19. Use openable windows in conjunction with mechanical ventilation to introduce fresh air. Care should be taken to ensure windows are properly closed at night and weekends during winter months to avoid the freezing of pipes and potential flooding.
20. Consider adopting a balancing schedule for mechanical ventilation systems every 5 years, as recommended by ventilation industrial standards (SMACNA, 1994).
21. Change filters for HVAC equipment as per the manufacturer's instructions or more frequently if needed.
22. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Drinking water during the day can help ease some symptoms associated with a dry environment (e.g., throat and sinus irritations).
23. Inspect gutters and downspouts around the perimeter of building periodically for proper drainage, clear debris as needed.

24. Seal areas around sinks to prevent water-damage to the interior of cabinets and adjacent wallboard.

25. Ensure plants have drip pans. Examine drip pans periodically for mold growth and disinfect with an appropriate antimicrobial where necessary. Remove plants from the air stream of mechanical ventilation.

26. Store cleaning products properly and out of reach of students. Ensure spray bottles are properly labeled. All cleaning products used at the facility should be approved by the school department with MSDS' available at a central location.

27. Relocate or consider reducing the amount of materials stored in classrooms to allow for more thorough cleaning. Clean items regularly with a wet cloth or sponge to prevent excessive dust build-up.

28. Clean exhaust/return vents and personal fans of accumulated dust periodically to prevent the aerosolization of dirt, dust and particulates.

29. Ensure water is poured into the restroom floor drain in room 132 every other day (or as needed) to maintain the integrity of the trap.

30. Consider adopting the US EPA document, *Tools for Schools* (US EPA, 2000), as a means to maintaining a good indoor air quality environment in the building. This document can be downloaded from the Internet at http://www.epa.gov/iaq/schools/index.html.

31. Consult "Mold Remediation in Schools and Commercial Buildings" published by the US Environmental Protection Agency (US EPA, 2001) for more information on mold. This document can be downloaded from the US EPA website at: http://www.epa.gov/iaq/molds/mold_remediation.html.

32. Refer to resource manuals and other related indoor air quality documents for further building-wide evaluations and advice on maintaining public buildings. Copies of these materials are located on the MDPH's website: http://mass.gov/dph/indoor_air

References

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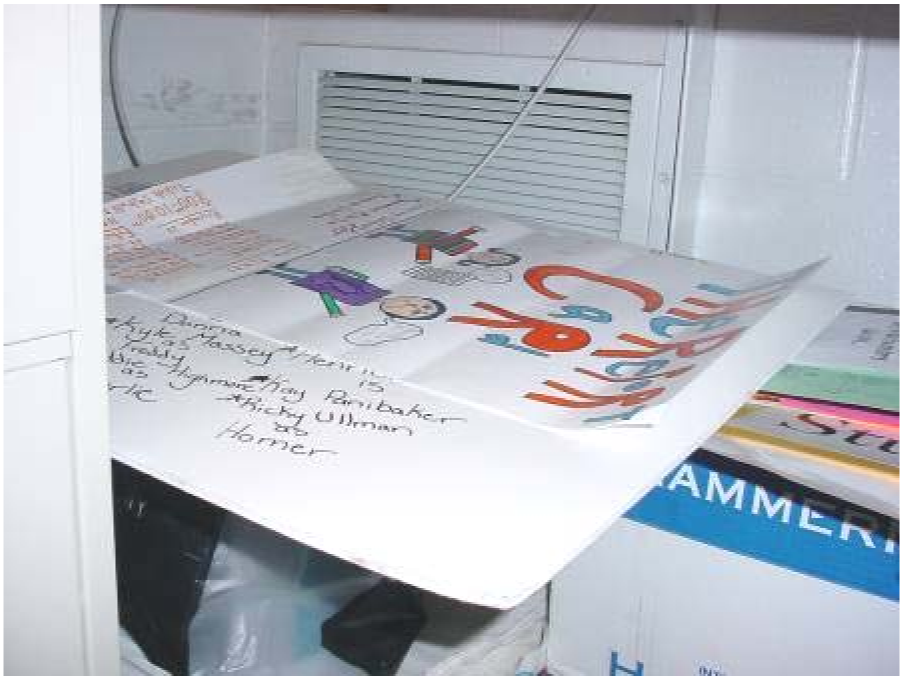
Picture 1

Items in front of supply vent

Picture 2

Personal fan placed on top of supply vent

Picture 3



Exhaust vent (located under a counter) blocked by boxes

Picture 4

Exhaust vent blocked by upholstered items

Picture 5

Classroom supply vent sealed with duct tape

Picture 6

NEAT center supply vent sealed with filtering medium and duct tape

Picture 7

NEAT center supply ducted outdoors

Picture 8

NES building exterior

Picture 9

Drainage for cement slab ledges

Picture 10

Disconnected downspout, note moss growth

Picture 11

Damaged downspout, note moss growth

Picture 12

Clogged drainage trough

Picture 13

Moss growth

Picture 14

Moss growth

Picture 15

Cracks in exterior cement wall

Picture 16

Cracks in exterior wall, note moss growth

Picture 17

Cracks in exterior wall, note moss growth

Picture 18

Media center fresh air intake

Picture 19

**Ledge drainage emptying into fresh air intake;
note pine needle disturbance and gravel accumulation**

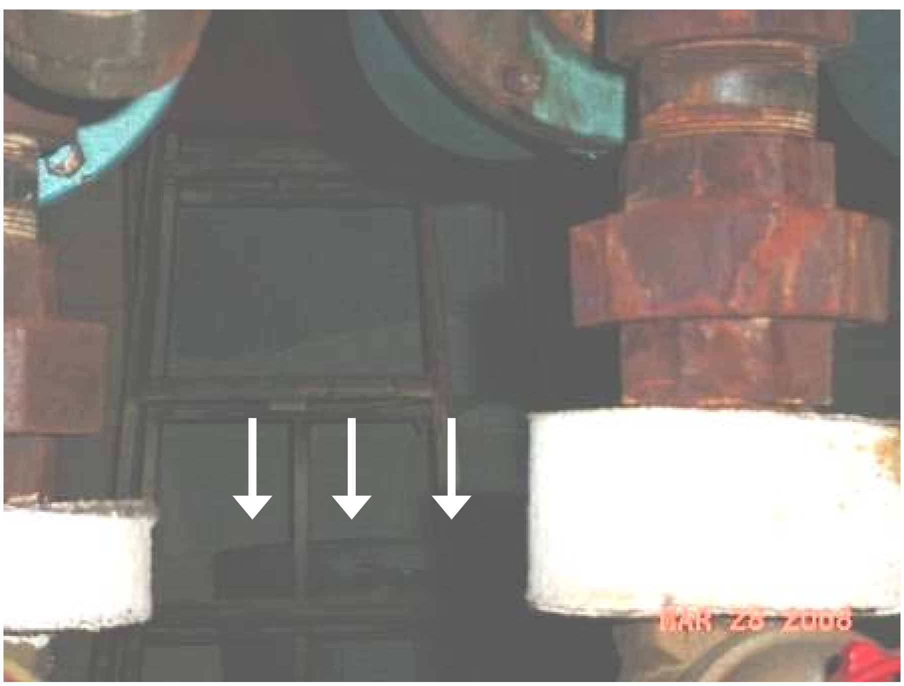
Picture 20

Media center AHU air intake

Picture 21

Media center duct work located partially in slab

Picture 22



AHU return duct terminating in wall of AHU room

Picture 23

Return air vent open to AHU room

Picture 24

AHU room floor drain

Picture 25

Water stains on bathroom floor

Picture 26

Pipes in cabinet off Room 111

Picture 27

Greenhouse shelf

Picture 28

Water at base of greenhouse shelf

Picture 29

Missing ceiling tiles

Picture 30

Water-damaged ceiling tiles around roof drain in gymnasium

Picture 31

Peeling paint on plaster

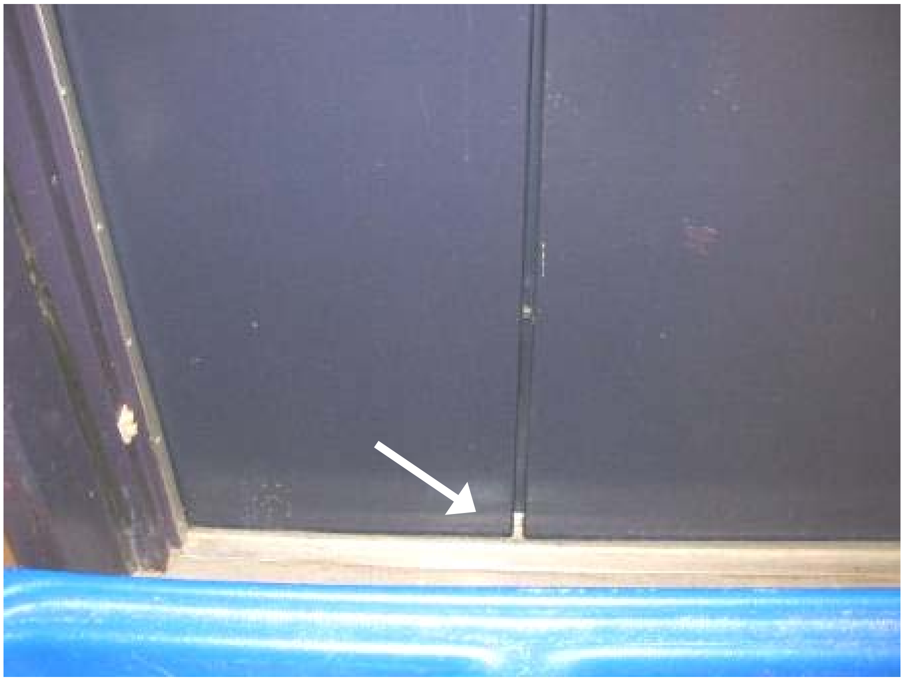
Picture 32

Water-damaged backsplash, peeling paint and wall plaster

Picture 33

Refrigerator on carpeting

Picture 34



Space in door

Picture 35

Media center, fresh air supply duct

Picture 36

Ductwork in crawlspace

Picture 37

Upholstered furniture

Picture 38

HEPA-filtered air purifier placed on the floor

Picture 39

Personal fan with dusty fan blades

Picture 40

Exhaust vent occluded with dust

Table 1

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	PM2.5 ($\mu g/m^3$)	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
background		61	30	431	ND	3				overcast
305	19	74	29	964	ND	13	Y	Y	Y	space between sink counter and wall; cleaners; WD plaster ceiling; UF; periodic leaks from skylights (wind driven rain)
306	23	75	27	808	ND	26	Y	Y	Y	unlabeled cleaners; space between sink counter and wall; chemicals under sink; sandbox
307	43	75	31	1036	ND	14	Y	Y	Y	exhaust vent passive into bathroom; windows open; space between sink counter and wall; UF; DO; 4 MT
308	17	75	28	881	ND	13	Y	Y	Y	shared exhaust; chemicals under sink; CT missing; peeling paint on walls; plant trays with soil
311	1	66	31	535	ND	4	Y	Y	N	supply vents sealed
377 KASE	0	70	24	490	ND	8	Y	Y	Y	
392	0	72	30	688	ND	7	Y	Y	Y	space heater; HEPA air filter; DO
404	0	70	31	513	ND	8	Y	Y	Y	windows open; cleaners; dust; DO; pet

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AD = air deodorizer
CD = chalk dust
CT = ceiling tile
DEM = dry erase materials
DO = door open
MT = missing ceiling tile
PF = personal fan
PS = pencil shavings
UF = upholstered furniture
WD = water-damaged

Comfort Guidelines

Carbon Dioxide:	< 600 ppm = preferred 600 - 800 ppm = acceptable > 800 ppm = indicative of ventilation problems
Temperature:	70 - 78 °F
Relative Humidity:	40 - 60%
Particle matter 2.5	< 35 ug/m^3

Location: Newman Elementary School, East Wing
Address: 1155 Central Ave, Needham, MA 02492

Table 1 (continued)

Indoor Air Results
Date: 3-28-2008

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	PM2.5 (μg/m³)	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
407	0	71	34	803	ND	6	N	unable to locate	Y	exhaust vents dusty
409	1	71	34	831	ND	9	N	Y	Y	exhaust vents dusty; DO; UF
Animal Center	1	75	26	702	ND	18	Y	Y	Y	caged animals
Auditorium	0	71	32	618	ND	9	N	Y	Y	
Cafeteria	175	74	30	952	ND	9	Y	Y	Y	
Gym	2	72	28	578	ND	8	N	Y	Y	23 students gone 20 mins; exhaust vents dusty; roof drain leak; WD ceiling
Gym Office	0	71	30	604	ND	7	N	passive	Y	fridge on carpet; DO
Health	2	69	30	605	ND	6	Y	Y	Y	supply vent duct taped; space heater on floor; HEPA air filter on floor
Media Center	0	67	33	596	ND	7-10	Y	Y	Y	supply vents sealed; aquarium; space between sink counter and wall; 10 MT; WD plaster ceiling

ppm = parts per million
μg/m³ = micrograms per cubic meter
ND = non detect
AD = air deodorizer
CD = chalk dust
CT = ceiling tile
DEM = dry erase materials
DO = door open
MT = missing ceiling tile
PF = personal fan
PS = pencil shavings
UF = upholstered furniture
WD = water-damaged

Comfort Guidelines

Carbon Dioxide:	< 600 ppm = preferred	Temperature:	70 - 78 °F
	600 - 800 ppm = acceptable	Relative Humidity:	40 - 60%
	> 800 ppm = indicative of ventilation problems	Particle matter 2.5	< 35 ug/m³

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	PM2.5 (μg/m^3)	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
Music	18	72	35	1108	ND	7	Y	Y	Y	DEM; stained CT
NEAT Center	0	71	26	490	ND	7	Y	Y	Y	supply vents sealed, ducted out; slight musty odor; cleaners; clutter; 24 computers (off); AC-window mounted
Office adjacent to 377	0	68	30	485	ND	11	Y	Y	N	space heater on floor
Principal	1	71	31	747	ND	8	Y	Y	Y	DEM; DO; space heater
Science Center Office	0	76	27	652	ND	6	Y	Y	Y	bee's nest; plants

ppm = parts per million
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MT = missing ceiling tile
PF = personal fan
PS = pencil shavings
UF = upholstered furniture
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%
Particle matter 2.5 < 35 ug/m^3

Location: Newman Elementary School, West Wing
Address: 1155 Central Ave, Needham, MA 02492

Table 2

Indoor Air Results
Date: 3-28-2008

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	PM2.5 ($\mu g/m^3$)	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
background		61	30	431	ND	3				overcast
100	21	75	25	628	ND	5	Y	Y	Y	exhaust vents blocked; windows open; DEM; DO
101	20	76	26	843	ND	5	Y	Y	Y	supply vents blocked; windows open
102	1	77	26	669	ND	4	Y	Y	Y	20 students gone 20 mins; UF
103	20	76	29	988	ND	7	Y	Y	Y	Windows open; PF; DEM; clutter
104	0	74	29	823	ND	5	Y	Y	Y	supply vents blocked; exhaust vents blocked; DO
105	0	75	30	872	ND	8	Y	Y	Y	DO
106	1	75	26	691	ND	5	Y	Y	Y	20 students gone 30 mins; supply vents blocked; DEM; PS
107	22	77	29	1196	ND	6	Y	Y	Y	plants on shelved-greenhouse, pool of water at shelf base; reuse of food containers

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AD = air deodorizer
CD = chalk dust
CT = ceiling tile
DEM = dry erase materials
DO = door open
MT = missing ceiling tile
PF = personal fan
PS = pencil shavings
UF = upholstered furniture
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Table 2 (continued)

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	PM2.5 ($\mu g/m^3$)	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
108	1	75	25	713	ND	7	Y	Y	Y	22 students gone 15 mins; supply vents blocked; exhaust vents blocked; objects hanging from ceiling; space under exterior door; DEM
109	0	74	28	713	ND	5	Y	Y	Y	DEM; PF; PS
110	18	75	27	775	ND	5	Y	Y	Y	supply vents blocked; DEM
111	15	76	26	817	ND	6	Y	Y	Y	supply vents blocked; exhaust vent blocked
112 PreSchool	9	74	26	661	ND	5	Y	Y	Y	
113	22	74	28	622	ND	5	Y	Y	Y	supply vents blocked; space between sink counter and wall; PF; PS
114	9	73	26	591	ND	8	Y	Y	Y	supply vents blocked; space between sink counter and wall; crack in cinderblock wall; DEM; UF
117	0	71	29	607	ND	7	Y	Y	Y	exhaust blocked by furniture; windows open; DEM

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AD = air deodorizer
CD = chalk dust
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DO = door open
MT = missing ceiling tile
PF = personal fan
PS = pencil shavings
UF = upholstered furniture
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	PM2.5 ($\mu g/m^3$)	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
118	20	73	31	865	ND	13	Y	Y	Y	supply vents blocked; exhaust vents dusty; objects hanging from ceiling; DEM
119	1	73	28	622	ND	9	Y	Y	Y	20 students gone 15 mins; supply vents blocked; exhaust vents weak; DEM
120	0	73	29	756	ND	7	Y	Y	Y	supply vents blocked; DEM
136	15	74	28	986	ND	4	Y	Y	Y	supply vents blocked; space under exterior door; DEM
200	22	77	25	795	ND	10	Y	Y	Y	supply blocked; exhaust vents off; windows open; DEM; PF
201	15	77	25	902	ND	10	Y	Y	Y	supply blocked; exhaust off; windows open; DEM; PF
202	14	76	29	963	ND	9	Y	Y	Y	windows open; clutter; cleaners; DO
203	18	76	28	885	ND	9	Y	Y	Y	windows open; PF; clutter
205	1	75	28	881	ND	8	Y	Y	N	windows open; PF; 1 WD CT; DO

ppm = parts per million
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Comfort Guidelines

Carbon Dioxide: < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Table 2 (continued)

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	PM2.5 (μg/m³)	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
207	1	73	26	823	ND	5	Y	Y	Y	windows open; DO
208	50	72	30	1295	ND	4	Y	Y	Y	exhaust vents weak; windows open, reported exhaust not working; cleaners
209	1	74	26	779	ND	7	Y	Y	Y	supply partially blocked; exhaust partially blocked, weak
210	20	74	27	707	ND	9	Y	Y	Y	windows open; PF
211	0	73	27	580	ND	7	Y	Y	Y	exhaust vents blocked by items; plants; clutter; windows open; fridge on carpet; DO; pets (dog & bird)
212	24	71	31	823	ND	11	Y	Y	Y	supply vent blocked; exhaust vent blocked; windows open; PF
213	1	74	27	615	ND	6	Y	Y	Y	20 students gone 20 mins; exhaust vents blocked by furniture; windows open; fridge on carpet; DEM; DO
214	17	76	30	1084	ND	13	Y	Y	Y	exhaust vents blocked by items; windows open; cleaners; AD; fridge on carpet

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DEM = dry erase materials
DO = door open
MT = missing ceiling tile
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Comfort Guidelines

Carbon Dioxide: < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Table 2 (continued)

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	PM2.5 (μg/m³)	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
215	0	74	27	697	ND	9	Y	Y	Y	exhaust off
216	1	75	26	595	ND	6	Y	Y	Y	exhaust vents blocked by furniture; fridge on carpet; CD; DO
217	23	72	30	754	ND	10	Y	Y	Y	supply vents blocked; plants; PF; PS
218	21	72	30	921	ND	10	Y	Y	Y	supply vents blocked; DEM; PF; microwave
219	20	74	31	1075	ND	12	Y	Y	Y	supply vents blocked; aquarium with snails; CD; DEM; PF
220	0	73	29	917	ND	6	Y	Y	Y	supply vents blocked; exhaust off; DEM
221	21	74	29	1105	ND	6	Y	Y	Y	windows open; HEPA air filter; DEM; PS
222	1	74	28	1047	ND	7	Y	Y	Y	20 students gone 7 min; exhaust vent above door; windows open
243	1	73	26	698	ND	9	Y	Y	N	plants; UF on floor
OT/PT	0	71	30	736	ND	4	N	Y	Y	

ppm = parts per million
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Comfort Guidelines

Carbon Dioxide: < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	PM2.5 ($\mu g/m^3$)	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
Restroom adjacent to Speech & Language	0	74	31	898	ND	10	N	N	Y	water damage floor stain
Speech & Language	2	74	26	537	ND	5	Y	Y	Y	supply vents blocked
Speech & Language Office	0	74	26	644	ND	5	Y	Y	Y	windows open; DEM; reports of flooding

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Comfort Guidelines

Carbon Dioxide: < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Table 3

Needham Public and Private School Asthma Prevalence 2002-2007

School Name	2003-2004 (Yr2)	2004-2005 (Yr3)	2005-2006 (Yr4)
Broadmeadow	8.58	5.98*	10.83
Hillside Elementary	10.26	10.89	12.69
John Eliot	15.81*	12.17	11.36
Monsignor Haddad Middle	11.9	N/R	N/R
Newman Elementary	8.14	10.6	9.69
Pollard Middle	10.49	9.51	8.46*
St. Joseph Elementary	9.79	N/R	N/R
St. Sebastian Country Day	N/R	N/R	16.49
Walker Home School	N/R	0	13.89
William Mitchell	9.27	9.09	10.5
Massachusetts Prevalence	**9.5**	**10.0**	**10.6**

N/R – Not Reported
* Statistically significant ($p < 0.05$)

Appendix A

Actions on Previous MDPH Recommendations

The following is a status report of actions taken on previous MDPH recommendations (**in bold**). The summary is based on reports from Newman Elementary School Officials, as well as photographs and observations made by MDPH staff.

- Continue to operate all ventilation systems throughout the building (e.g. gym, auditorium, classrooms) continuously during period of school occupancy to maximize air exchange.
  Action Taken: Completed.

- Work with HVAC vendor to examine methods of increasing fresh air intake.
  Action Taken: Completed.

- Remove all obstructions from supply and exhaust/return vents to facilitate airflow.
  Action Taken: MDPH staff found supply and exhaust/return vents blocked in numerous areas throughout the building during the March 2008 assessment.

- Ensure classroom doors are closed to improve air exchange.
  Action Taken: MDPH staff observed many door classroom/hallway doors open during the March 2008 assessment.

- Use openable windows in conjunction with mechanical ventilation to introduce fresh air. Care should be taken to ensure windows are properly closed at night and weekends during winter months to avoid the freezing of pipes and potential flooding.

Appendix A

Action Taken: Newman School Administration reportedly recommends the opening of windows.

- Consider adopting a balancing schedule for mechanical ventilation systems every 5 years.

  Action Taken: Newman School Administration has concluded that it is not practical considering system's age.

- Replace damaged ductwork insulation in lobby fan room.

  Action Taken: This item was reportedly on a work list to be completed.

- Change filters for HVAC equipment as per the manufacturer's instructions or more frequently if needed.

  Action Taken: Scheduled for completion throughout the school year.

- Inspect gutters and downspouts around the perimeter of building periodically for proper drainage, clear debris as needed.

  Action Taken: MDPH staff found gutters and downspouts damaged or missing during the March 2008 assessment.

- Seal areas around sinks to prevent water-damage to the interior of cabinets and adjacent wallboard.

  Action Taken: MDPH staff found several areas with spaces between sink countertops during the March 2008 assessment.

Appendix A

- Ensure plants have drip pans. Examine drip pans periodically for mold growth and disinfect with an appropriate antimicrobial where necessary. Remove plants from the air stream of mechanical ventilation.

  Action Taken: A poorly maintained shelved-greenhouse was noted in one classroom. MDPH staff found trays of soil near supply vents in a few classrooms. Further, plants were found in the air flow of mechanical ventilation.

- Store cleaning products properly and out of reach of students. Ensure spray bottles are properly labeled. *All* cleaning products used at the facility should be approved by the school department with MSDS' available at a central location.

  Action Taken: MDPH staff found cleaners atop counters and tables in many classrooms during the March 2008 assessment.

- Relocate or consider reducing the amount of materials stored in classrooms to allow for more thorough cleaning. Clean items regularly with a wet cloth or sponge to prevent excessive dust build-up.

  Action Taken: MDPH staff found many classrooms storing large amounts of materials during the March 2008 assessment.

- Clean exhaust/return vents and personal fans of accumulated dust periodically to prevent the aerosolization of dirt, dust and particulates.

  Action Taken: MDPH staff found accumulated dirt, dust and debris on exhaust/return vents during the March 2008 assessment.

Appendix A

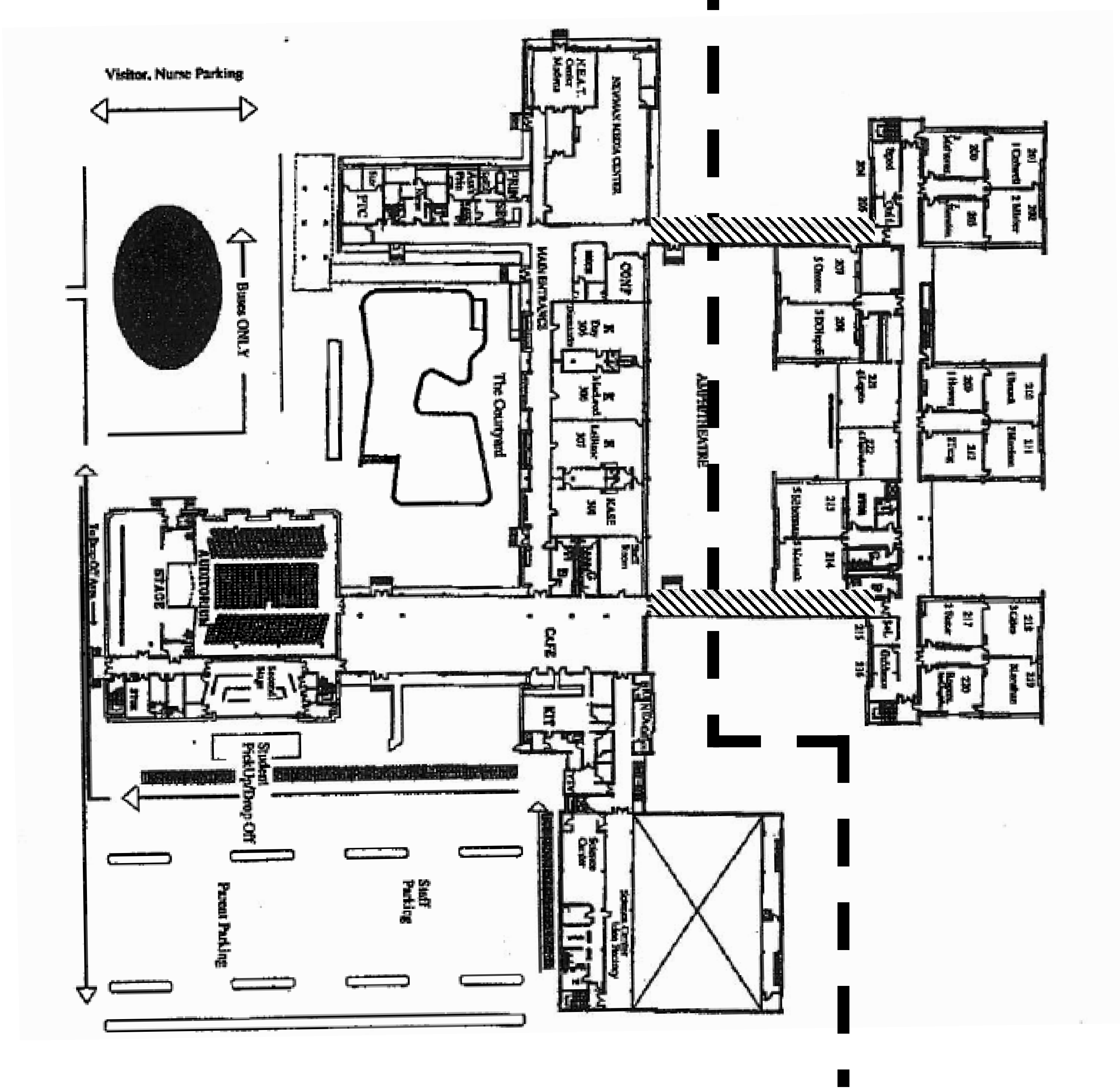
- Ensure water is poured into the restroom floor drain in room 132 every other day (or as needed) to maintain the integrity of the trap.

  Action Taken: **No action was reported on this recommendation.**

Map 1

Classroom Layout of Newman Elementary School, Upper Level
(Dotted line separates East and West Wings)

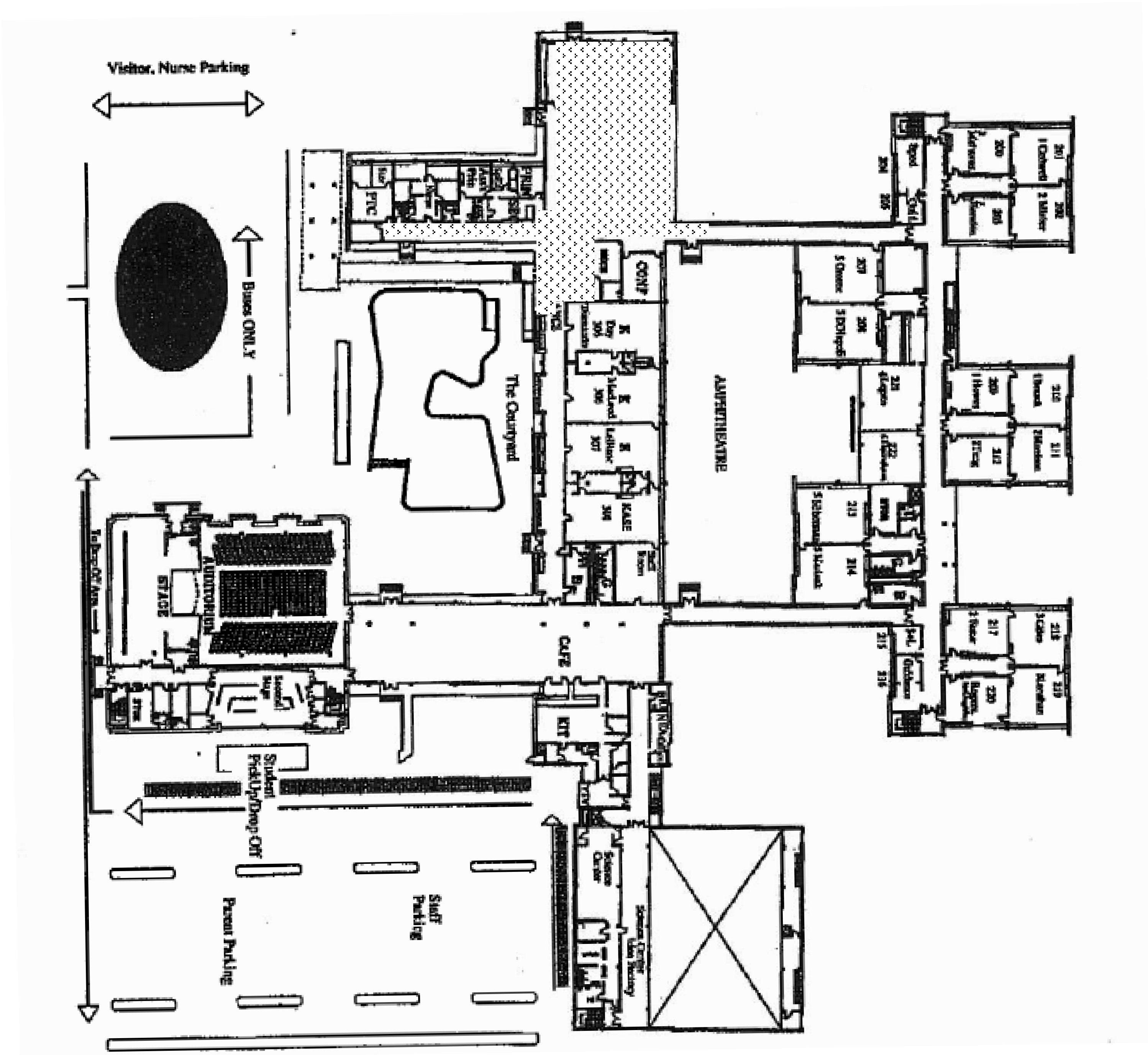
East Wing West Wing



= heated walkways

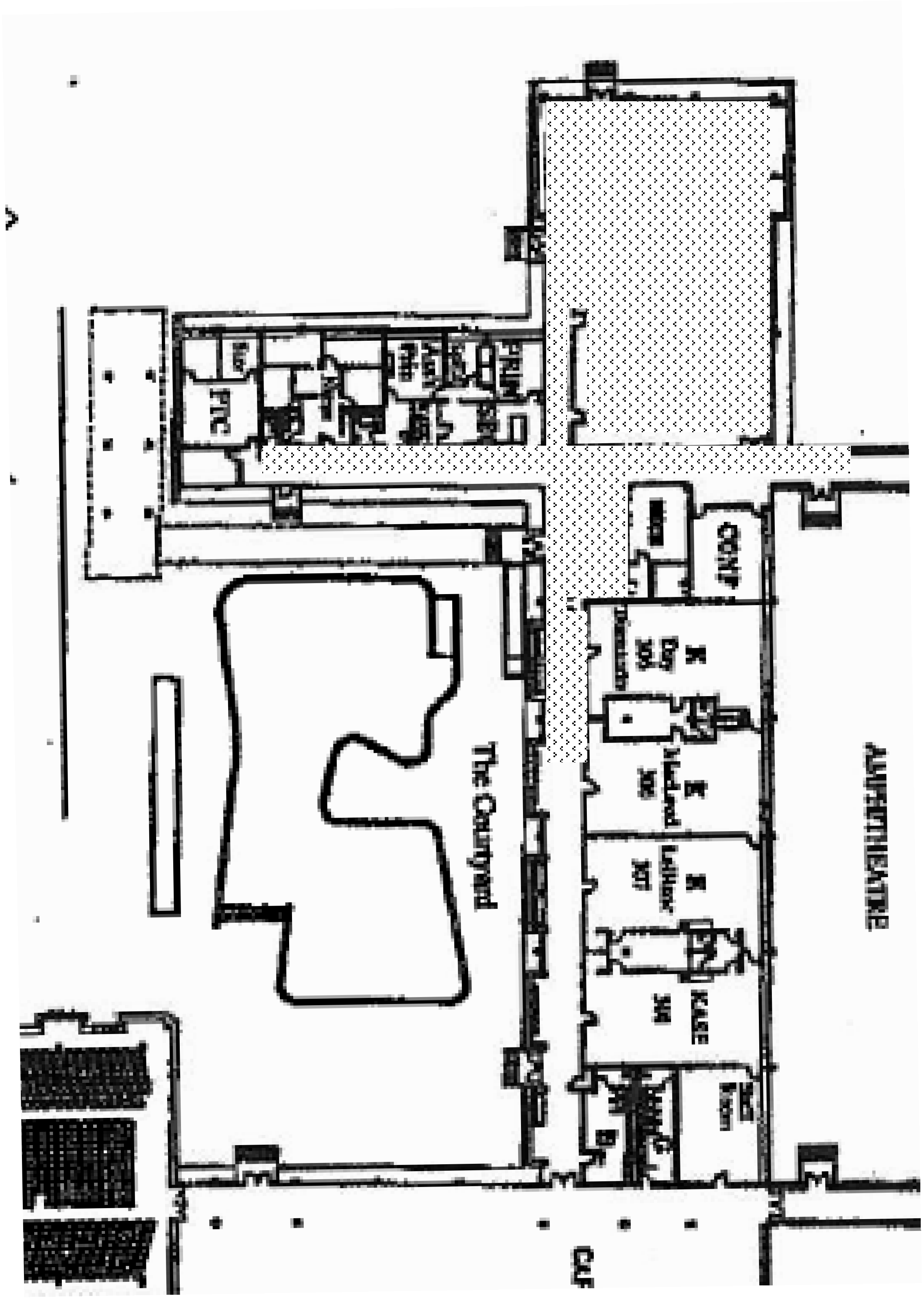
Map 2
Location of Odor Confined to Southern Portion of East Wing Only

East Wing West Wing



= location of musty odors

Map 3
Location of Odor Confined to Southern Portion of East Wing Only



= location of musty odor